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Runoff generation in a Mediterranean area: experiments and dominating processes across spatial scales

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Traditional hydrometric measurements were combined with tracer hydrological investigations to study runoff generation processes at different spatial scales in steep carbonate hillslopes of the Judaean (West Bank) Mountains, West Bank and Israel. In the 180 m2 plot scale, artificial tracers, added to the waters of a two-days sprinkling experiment, enabled a two-component hydrograph separation emphasizing the important role of shallow surface depressions, soil cover and subsoil morphology in runoff generation. Surface runoff was a combination of infiltration excess runoff on rocky parts and saturation excess runoff from saturated soil pockets. At the end of the experiment almost the entire plot was saturated and 80 - 90% of the applied rainfall was converted into immediate surface runoff. At the hillslope scale continuous FDR soil moisture measurements supported the above theory also under natural rainfall conditions. A 0.8 ha rocky slope responded at high moisture state, while on the opposite slope deep soils and terraces prevented surface runoff. On the rocky slope fluorescence tracers proved flow connections from the very hillslope top down to its base. Calculated infiltration rates depended strongly on the soil moisture state and significant slope runoff (25%) was only recorded close to saturation. Consequently a 1.1 km2 headwater wadi only responded after 390 mm of accumulated seasonal rainfall. While tracer concentrations in subsurface sources remained rather constant, lowly mineralized samples indicated dilution during storm events in another 2.6 km2 wadi. During one event the temporal dynamics of deuterium provided independent evidence for storm water impact both at the hillslope and the small catchment scale. It is hypothesized that saturation excess runoff from steep slopes with only patchy soil cover dominates flood generation. These slopes act as a flood generating zone rather than

as an area of pronounced infiltration and recharge into the underlying regional karst aquifer.